2:15

849-2 Myocardial Blood Volume Decreases Distal to a Stenosis During Hyperemia: Basis for Stenosis Detection by Contrast Echo

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Background: Perfusion defects are noted on myocardial contrast echocardiography (MCE) during hyperemia in regions supplied by coronary stenoses. Since myocardial video intensity (MVI) denotes myocardial blood volume (MBV) rather than myocardial blood flow (MBF), we hypothesized that MBV actually decreases distal to a stenosis during hyperemia compared to normal myocardium.

Methods: We created coronary stenoses in 8 dogs of varying severities (3–4) which did not change resting MBF. AFO150 (Alliance Pharmaceutical), was administered intravenously as continuous infusions. Plateau MVI measurements were obtained from MVI versus pulsing interval curves during intermittent harmonic imaging. Myocardial vascular resistance (MVR) was calculated by dividing coronary driving pressure (pressure gradient between the coronary artery distal to the stenosis and the right atrium) by epicardial coronary blood flow.

Results: In the presence of hyperemia, plateau MVI progressively decreased with increasing stenosis despite the same concentration of microbubbles being infused at a constant rate. This finding indicates a decline in MBV with progessive stenosis which correlated inversely with an increase in MVR ($r = -0.71$ to -0.99 in individual dogs, with mean $r = -0.94$). MVI remained unchanged in the normal bed.

Conclusions: Compared to a normal bed, MBV decreases distal to a stenosis during hyperemia. The magnitude of MBV decrease is proportional to stenosis severity, which forms the basis for stenosis detection by MCE when used with coronary vasodilators.

2:30

849-3 Evaluation of Coronary Reserve in the Left Anterior Descending Coronary Artery by Contrast-enhanced Transthoracic Harmonic Echo Doppler

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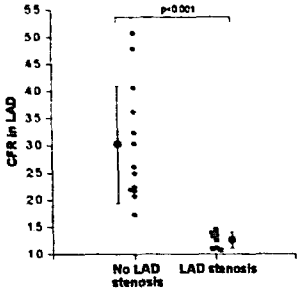
Background: We tested the hypothesis that blood flow velocity could be recorded in the left anterior descending coronary artery (LAD) during transthoracic echocardiography using II Harmonic echo Doppler along with contrast enhancement (intravenous Levovist®) at rest and after pharmacological-induced maximal vasodilation in order to assess coronary flow reserve (CFR) (the ratio between maximal and basal flow) by a totally non invasive approach.

Methods: Twenty one consecutive patients (pts) undergoing coronary angiography were submitted to transthoracic contrast-enhanced pulsed wave (PW) Doppler recording of blood flow velocity in the LAD using Harmonic color Doppler as a guide, at rest and after maximal vasodilation by dipyridamole infusion (Dip).

Results: Contrast enhancement along with Harmonic mode greatly enhanced success rate in recording adequate PW Doppler signal from the LAD, this signal being of optimal quality before contrast in only 17% of pts at rest and in 5% after Dip whereas after contrast it was obtainable in all pts both at rest and after dipyridamole (success rate = 100%) being of optimal quality in 94% of pts at rest and in 90% after Dip ($p < 0.001$). Coronary angiography revealed a significant LAD stenosis (lumen narrowing ≥70%) in 8 pts whereas in 13 it did not. There was a significant difference and no overlapping in CFR measured in pts with and without significant LAD stenosis; CFR for peak diastolic velocity was (Mean ± SD): 3.02 ± 1.08 in no-LAD- stenosis pts and 1.26 ± 0.15 in the LAD-stenosis pts (see graph).



Conclusion: Contrast-enhanced transthoracic echo Doppler along with Harmonic mode is a feasible and very promising technique for assessing LAD CFR in a totally non invasive way.

2:45

849-4 Quantification and Time Course of Microvascular Obstruction by Contrast-enhanced Echocardiography and Magnetic Resonance Imaging Following Acute Myocardial Infarction and Reperfusion

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Background: Post-infarction microvascular obstruction (MO) results when prolonged ischemia causes infarct core microvessel occlusion. Though contrast echocardiography (CE) has been used to study MO, MO spatial extent by CE has not been validated against thioflavin-S staining and MRI, which yield precise maps of MO. MO expands up to 48 hours post-reperfusion; the time course >2 days is unknown.

Methods: Ten dogs underwent 90 minute coronary artery occlusion with reperfusion. CE and MR imaging occurred at 2 and 9 days post-reperfusion. MO regions were planimetered and expressed as % LV mass. Radioactive microspheres were injected for blood flow determination. Post-mortem myocardial staining with thioflavin-S was done.

Results: MO by CE corresponded spatially to MRI hypoenhanced and thioflavin-negative regions. MO measured 12.94 ± 4.51% by CE; 7.11 ± 3.68% by MRI; 9.18 ± 4.32% by thioflavin-S (repeated measures ANOVA $p < 0.001$). MO by CE was larger than thioflavin-S and was moderately correlated ($r = 0.72$). MO by MRI was smaller than thioflavin-S and was well-correlated ($r = 0.81$). By microspheres, blood flow (% of remote) to MO regions was 1.5 ± 1.2% at occlusion; 41.1 ± 18.1% at day 2; 69.5 ± 24.9% at day 9 (day 2 vs. 9, $p < 0.03$). MO size was unchanged at 2 and 9 days (CE: 13.23 ± 4.11% vs. 12.69 ± 4.97%; MRI: 5.53 ± 4.94% vs. 4.68 ± 3.44%; p = NS for both).

Conclusions: Both CE and MRI can effectively quantify MO. While flow to MO regions increases over time suggesting local recanalization, MO spatial extent is unchanged at 2 and 9 days post-reperfusion.

3:00

849-5 Assessment of Changes in Myocardial Perfusion During Coronary Angioplasty Using Intravenous Contrast Echocardiography

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Background: With the advent of intravenous microbubble contrast agents and second harmonic (SH) echocardiographic imaging, the non-invasive detection of myocardial perfusion is now possible. To date, the technique has not been used to assess the effect of acute changes in coronary flow in humans.

Methods: 214 intravenous injections of FS069 (Molecular Biosystems Incorporated), mean volume 0.24 ± 0.08 mls were administered to 20 patients before, during and after coronary angioplasty of 21 lesions (11 anterior descending, 5 circumflex, 5 right) during intermittent SH imaging using an Hewlett Packard Sonos 5500 system. End systolic SH images were stored on optical disc for subsequent analysis of SH signal intensity in relevant segments before and during IV FS069. Mean percentage (m%) change from baseline was determined. 19, 14 and 60 interpritable studies were obtained before, during and after angioplasty.

Phase	m% (±SD)	p value, vs baseline
Pre angioplasty	55.6 ± 51.0	<0.001
Occlusion	32.3 ± 37.2	0.006
Reflow	60.8 ± 51.3	<0.001
Post angioplasty	59.3 ± 43.7	<0.001

Results: SH myocardial backscatter became significantly more intense in the presence of FS069 through all phases of the study. This also occurred during coronary occlusion by balloon inflation, however subsequent deflation and reflow resulted in even greater enhancement ($p = 0.001$). Importantly, this increase in reflow was only significant in patients with normal wall motion, or normal electrocardiograms before intervention ($p = 0.002$).

Conclusion: Intravenous myocardial contrast echo appears to demonstrate the perfusion changes of acute coronary occlusion and reperfusion with important clinical implications. The confounding effects of infarction, collateral flow and vasodilators require further study.